ALLIANCE
TECHNICAL SERVICES, INC.

DOE Hydrogen Program

Analysis Repository

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May 16, 2007

ANP-5

Overview

Timeline

- Start: FY 2005
- Ongoing
- 60% complete

Budget

- Total project funding:
  - 100% DOE
- FY06 Budget:
  - ATS: $26,000
  - NREL: $29,000
- FY07 Budget:
  - ATS: $26,000 (est.)
  - NREL: $15,000 (est.)

Systems Analysis Barriers Addressed

- B. Stove-piped/Siloed Analytical Capability
- D. Suite of Model and Tools
- E. Unplanned Studies and Analysis

Partners

- National Renewable Energy Laboratory

Objectives

- **Create a searchable online database of hydrogen-related analyses.**
- **Populate the database with as many hydrogen-related analyses as practical, both DOE- and non-DOE-funded.**
- **Develop a user-friendly interface that provides the needed functionality, particularly regarding search capabilities.**

Approach

- **Identify projects for inclusion in the Repository**
  - **All DOE-funded systems analysis projects from present time back to 1995 (component analyses excluded)**
  - **Other federally funded hydrogen-related analyses conducted since 1995**
  - **Privately and internationally sponsored hydrogen-related analyses conducted since 1995**
- **Determine data needs**
- **Gather data**
  - **Publications**
  - **Principal investigators**
- **Develop database of projects**
- **Create searchable online tool for displaying the data**

Index Card Approach

The repository is, at a minimum, like a library catalogue. Each entry in the repository should contain enough information on the analysis or model to identify its general purpose and scope and enable the user to locate further information.

Input Form – Required Data

REPOSITORY DATA SHEET

Required Section. The information on this page is required in order for your project to be entered into the repository.

Title: Common title used to identify model (both long form and short form or acronym). If the project previously had a different title, please provide past titles as well.	**Index #:** To be completed by administrators

Sponsor Name: **Sponsor Organization:**	**Sponsor Phone Number:** **Sponsor Email Address:**
Type of Project: ☐ Analysis ☐ Model ☐ Both	**Date This Form Last Updated:**
Performer/PI: **Organization:**	**Performer Physical Address:** **Performer Phone Number:** **Performer Email Address:**

Additional Performers (subcontractors/teammates): lab, company, university, etc. (please provide name and organization of each additional performer)

Contact Information for User Questions (if other than PI):

Period of Performance: **Start (month, year):** **End (month, year):**	**Timeframe Studied (range of years, e.g. 2005-2020):**
Purpose of Analysis/Model: Describe why the analysis or model is needed.	**Category (choose all that apply; descriptions given on next page):** ☐ Hydrogen fuels pathway ☐ Vehicle options ☐ Well-to-wheels ☐ Energy infrastructure ☐ Macro-economic ☐ Environmental ☐ Cross-cutting

Objectives (i.e., Question(s) to Be Answered by the Analysis/Model):
Separate with semicolons.

Description of Categories

- Hydrogen fuel pathways
  - Includes resource analysis, production and delivery pathway analysis, transition modeling specific to hydrogen fuel pathways, cost analysis and modeling relevant to hydrogen fuel, and lessons learned from other alternative fuels specific to development of a hydrogen infrastructure
- Vehicle options
  - Includes vehicle systems analysis, vehicle penetration analysis/modeling/forecasting, market/consumer analysis for both transition and long-term, lessons learned from other AFVs, competitive impacts (plug-ins, hybrids, etc.), cost analysis and modeling specific to vehicle options
- Well-to-wheels
  - Assessment of life cycle impacts of technologies, including impacts of feedstock recovery, fuel production, fuel delivery, and vehicle operation

Description of Categories

- Energy infrastructure
  - Includes macro-system modeling as well as analysis and modeling of non-hydrogen energy infrastructures
- Macro-economic
  - Analysis and modeling of macro-economic systems
- Environmental
  - Includes analysis of environmental effects of hydrogen, hydrogen infrastructure, fuel cells, etc.
- Cross-cutting
  - Includes analysis of infrastructure elements needed to support a hydrogen economy, including water, fuel quality, etc.

Input Form – Optional Data

REPOSITORY DATA SHEET

Optional. This page and the pages following are to provide additional information on your project. This will help users of the repository quickly and easily obtain useful information on your project without contacting you.

All Projects

Methodology/Approach: List models and techniques used in conducting the analysis or model; e.g., discounted cash flow analysis, Monte Carlo simulation, linear algebraic calculation. Separate with semicolons.

Outputs: List the outputs of the analysis or model; e.g., delivered cost of hydrogen, WTW energy use and CO2 emissions, etc. Separate with semicolons.

Keywords: The data contained in this data sheet will be included in a repository. Search capability will be included to make the data accessible to the analysis community. Please list up to 15 keywords that should be used to find this model with a search engine. Separate with semicolons.

Milestones Supported by this Project: Does your project support any DOE Hydrogen Program (or other government entity) decision/milestones? For list of DOE Hydrogen Program milestones, see the RD&D Plan at http://www.eere.energy.gov/hydrogenandfuelcells/mypp/

Organization with Milestone	Description of Milestone	How does your project contribute to achieving the milestone?	Completion Date (can be expected date if not yet achieved): month, year

Project Reviews: List and attach any project reviews that have been completed. Provide URLs if available.

Title	URL

Input Form – Optional Data Analyses

Analyses Only			
Technologies Considered: List all technologies that are analyzed, e.g. steam methane reforming; fuel cell vehicles; metal hydride hydrogen storage. Separate with semicolons.			
Models Used: List models used in conducting the analysis, including both commercially available and proprietary models. Separate with semicolons.			
Assumptions: List the key assumptions affecting the results of the analysis. Separate with semicolons.			
Sensitivities Studied: List the independent and dependent variables for any sensitivity studies that were conducted. Separate with semicolons.			
Inputs: Describe the inputs to the analysis, e.g. hydrogen production rate, feedstock costs.			
Description	**Value (please enter a number only)**	**Units**	**Supporting Information (example: At 5,000 psig)**

Input Form – Optional Data – Models

Models Only			
Technologies Modeled: List all technologies that are modeled, e.g. steam methane reforming; fuel cell vehicles; metal hydride hydrogen storage. Separate with semicolons.			
User Inputs: Describe the inputs to the model, e.g., hydrogen production rate; feedstock costs. Separate with semicolons.			
Model Hardware/Software Requirements: List hardware and software requirements for running the model, including hard drive storage, software programs, speed requirements, etc. Separate with semicolons.			
User Interface: Is there a GUI? If yes, describe it (executable file, etc.)			
Assumptions Inherent in the Model: List the key assumptions affecting the results of the model that are not user inputs. Separate with semicolons.			
Sensitivities Studies Facilitated: List the independent and dependent variables for any sensitivity studies that can be conducted using the model. Separate with semicolons.			
Inputs: Describe the inputs to the analysis, e.g. hydrogen production rate, feedstock costs.			
Description	**Value (please enter a number only)**	**Units**	**Supporting Information (example: At 5,000 psig)**

Input Form – Optional Data Work Products

PRODUCTS / DELIVERABLES	
List the expected outputs and products of the project, e.g., reports, SOW, briefings/presentations, models, model descriptions/users' manuals, etc. Fill out all applicable fields below. Required fields are marked with an asterisk (*). Attach deliverables or list the URLs where they can be found. Please copy this table and repeat for each product and deliverable for the project.	
***Product Description:**	
Publication Title:	
Article/Abstract Title:	
Article/Abstract Page Number:	
Name of Publisher:	
Type of Publication:	
Publication Notes:	
Author Name:	
URL:	
***Pub. Date (month, year):** For a model, this is the date of release of the listed version of the model	

Input Form – Optional Data – Related Studies

RELATED STUDIES

Optional. The information on this page will help to identify additional projects that should be included in the repository and to draw relationships between repository entries.

Data Used/Contributing Research:

List any previous or concurrent studies that were used in the analysis, used in the model or in developing the model, databases used, or research that contributed to the results.

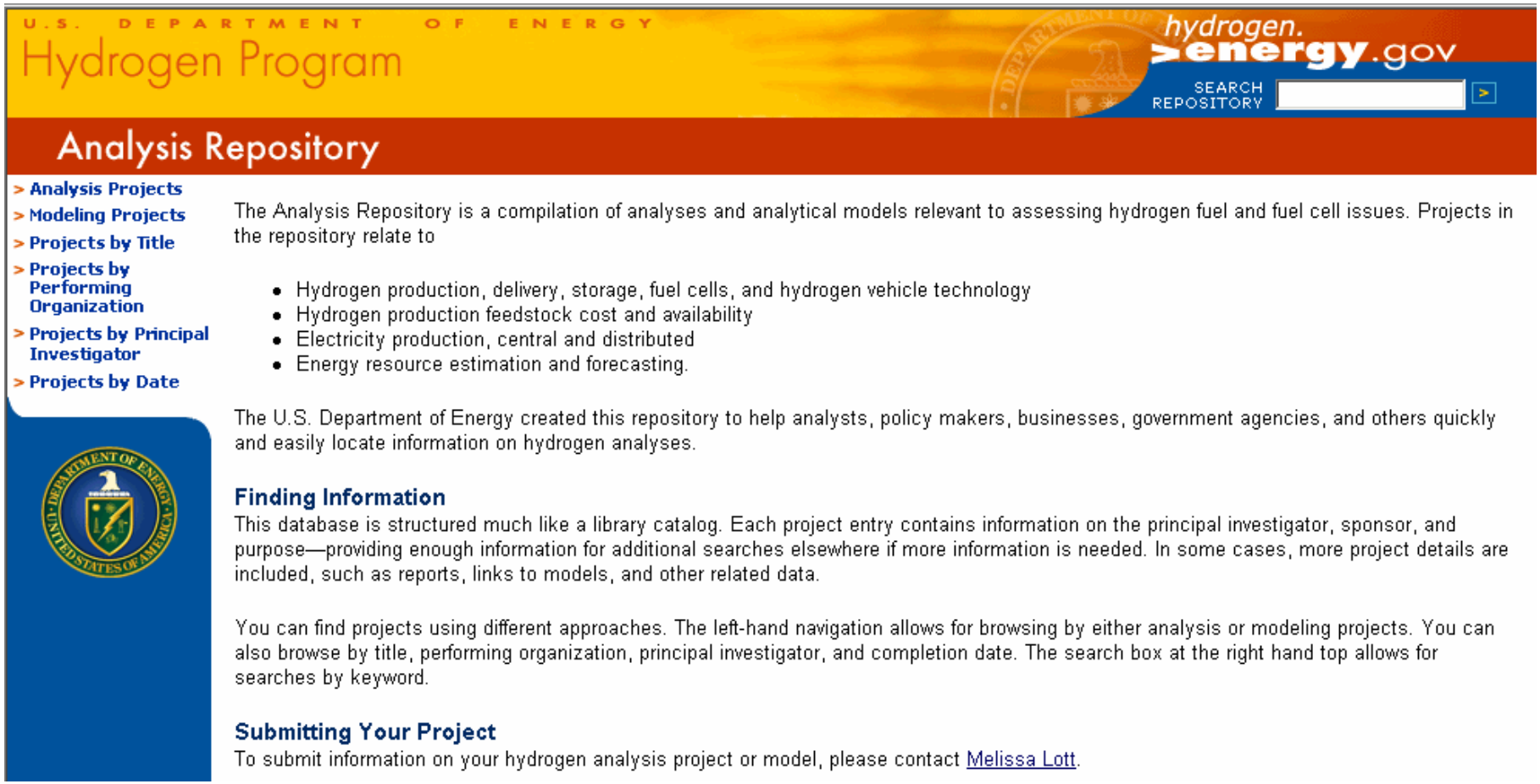
Description of Contributing Research	URLs to Contributing Studies, Databases, etc.

Related Analyses and Models:

List any analyses or models that contributed to your project, any complementary analyses or models, and any analyses or models that used the results or products of your project. Include the relationship to your project and the location (URL or physical address) where the related analyses can be found (if possible). You need not duplicate any of the items listed above as contributing research.

Title:	**Relationship** (does the analysis listed contribute to your project, complement your project, use the results of your project, or is it related another way?):	URL:	Organization
	☐ Contributor ☐ Complementary ☐ User ☐ Other		
	☐ Contributor ☐ Complementary ☐ User ☐ Other		
	☐ Contributor ☐ Complementary ☐ User ☐ Other		

Analysis Repository is live!



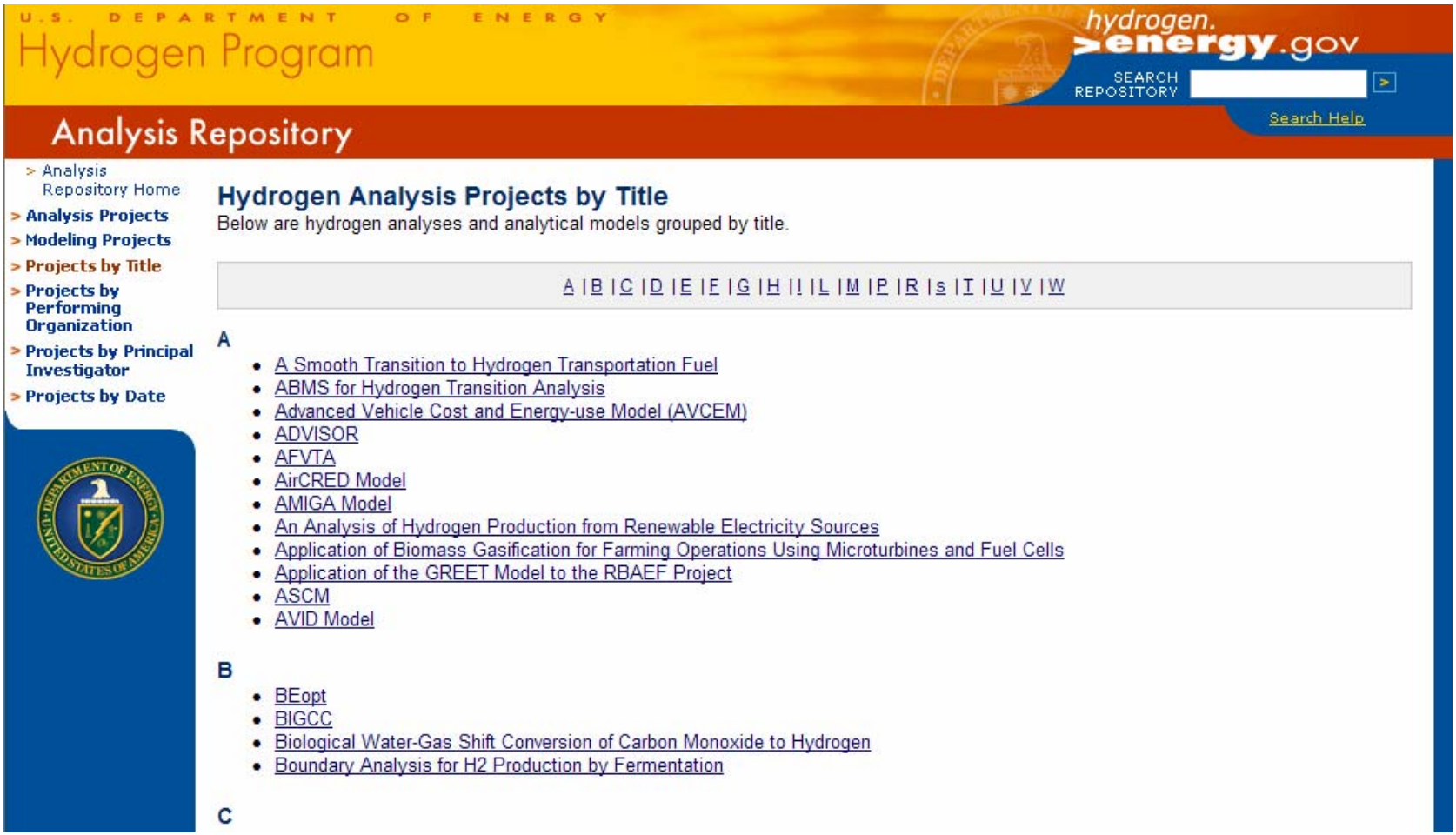
http://www.hydrogen.energy.gov/analysis_repository/

Accomplishments

- **Analysis Repository went live on May 8**
- **Approximately 75 projects included**
- **Projects are sorted by**
  - **Type of analysis/model (cross-cutting, energy infrastructure, environmental, hydrogen fuel pathways, macro-economic, vehicle options, well-to-wheels)**
  - **Model vs. analysis**
  - **Title**
  - **Performing organization**
  - **Principal investigator**
  - **Date**
- **Search feature is available**

Analysis Projects Sorted by Category

Analysis Projects Sorted by Title



Analysis Projects Sorted by Performing Organization

Sample Project – Part 1

Cost Analysis of Hydrogen Storage Systems

Project Summary

Full Title:	Cost Analysis of Hydrogen Storage Systems
Project ID:	DOE-145
Principal Investigator:	Stephen Lasher
Sponsor Name(s):	Sunita Satyapal
Keywords:	Hydrogen storage; lifecycle costs; compressed hydrogen tanks

Purpose

The purpose of this analysis is to help guide researchers and developers toward promising R&D and commercialization pathways by evaluating the various on-board hydrogen storage technologies on a consistent basis.

Performer

Principal Investigator: Stephen Lasher

Organization: TIAX, LLC

Address: Acorn Park
Cambridge, MA

Telephone: 617-498-6108

Email: lasher.stephen@tiaxllc.com

Additional Performers: John Bowman, TIAX LLC; Matt Hooks, TIAX LLC; Mark Marion, TIAX LLC; Stephan Unnasch, TIAX LLC; Yong Yang, TIAX LLC

Sample Project – Part 2

Project Description

Type of Project:	Analysis
Category:	Environmental, Hydrogen Fuel Pathways, Vehicle Options, Well-to-Wheels
Objectives:	Compare different on-board hydrogen storage approaches in terms of lifecycle costs, energy efficiency and environmental impact; Identify and compare other performance aspects that could result in barriers to successful commercialization (e.g., on-board system weight and volume); Examine the effects of system-level cost and performance trade-offs for different storage approaches; Project performance and cost relative to DOE targets
Technologies Considered:	Sodium alanate; Sodium borohydride; Magnesium hydride; Carbon fiber compressed gaseous tanks; Cryo-compressed tanks; Liquid Hydrogen tanks; Reversible on-board hydrogen storage; Regenerable off-board hydrogen storage; High surface area sorbents
Methodology/Approach:	System-level conceptual designs will be developed for each on-board storage system and required fueling infrastructure. In-house activities- and product-based cost models will be utilized to determine high-volume manufactured cost projections for the on-board storage system. Monte Carlo simulation will be used for cost sensitivity analyses. H2A-based discounted cash flow models will be used to estimate hydrogen selling prices based on the required off-board hydrogen infrastructure.
Models Used:	In-house activities- and product-based cost models will be utilized to determine high-volume manufactured cost projections for the on-board storage system. H2A-based discounted cash flow models will be used to estimate hydrogen selling prices based on the required off-board hydrogen infrastructure.
Outputs:	On-board storage system cost and performance; delivered cost of hydrogen; lifecycle or well-to-wheel cost, primary energy use, and environmental impact
Sensitivities Studied:	Single variable sensitivity analyses were run on the overall sodium alanate system cost, weight, and volume for four system parameters: media reversible hydrogen capacity (H2 wt%), media cost ($/kg), tank carbon fiber layer thickness (mm) and media relative packing density.

Sample Project – Part 3

Products/Deliverables

Description: Abstract in FY 2005 Progress Report for the DOE Hydrogen Program
Title: *FY 2005 Progress Report for the DOE Hydrogen Program*
Article/Abstract Title: Analyses of Hydrogen Storage Materials and On-Board Systems
Page number(s): 671
Publisher: U.S. Department of Energy
Type of Publication: Annual Progress Report
Author Name(s): Lasher, Stephen
(PDF 360 KB) Download Adobe Reader.
Publication Date: October 2005

Description: Abstract in FY 2004 Progress Report for the DOE Hydrogen Program
Title: *FY 2004 Progress Report for the DOE Hydrogen Program*
Article/Abstract Title: Analyses of Hydrogen Storage Materials and On-Board Systems
Page number(s): 258
Publisher: U.S. Department of Energy
Type of Publication: Annual Progress Report
Author Name(s): Lasher, Stephen
(PDF 207 KB) Download Adobe Reader.
Publication Date: December 2004

Description: Abstract in FY 2006 Progress Report for the DOE Hydrogen Program
Title: *FY 2006 Progress Report for the DOE Hydrogen Program*
Article/Abstract Title: Cost Analysis of Hydrogen Storage Systems
Page number(s): 535
Publisher: U.S. Department of Energy
Type of Publication: Annual Progress Report
Author Name(s): Lasher, Stephen
(PDF 1.4 MB) Download Adobe Reader.
Publication Date: October 2006

FY 2007/2008 Plans

- **Collect data on additional projects and update/expand data on existing projects in the Repository**
- **Solicit feedback from the analysis community to improve both the data and the structure of the Repository tool**
- **Implement improvements based on feedback – evolve the tool so that it can become a valuable resource for the analysis community and decision-makers**

Summary

Relevance: The Repository is a tool for analysts and decision-makers to find information on analyses and models quickly and easily.

Approach: Develop a searchable online database containing, at a minimum, the purpose of each analysis and modeling project and a means of locating more information.

Accomplishments and Progress: Analysis Repository is live and contains ~75 entries.

Proposed Future Plans: Expand and add entries; solicit feedback from analysis community and incorporate improvements.

Questions? Suggestions?

Your input is important to us!

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